

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-070127

(43)Date of publication of application : 10. 03. 1998

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(51) Int. Cl.

H01L 21/321

H01L 21/60

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(54) METHOD FOR FORMING ELECTRONIC COMPONENT HAVING PUMP ELECTRODE AND THE BUMP ELECTRODE AND BONDING METHOD FOR THE ELECTRONIC COMPONENT HAVING BUMP ELECTRODE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a specified structure of solder bump electrode difficult to deform.

SOLUTION: The bump electrode comprises a columnar body 29 made of a high m.p. solder (e.g. Pb 95%Sn 5% m.p. about 310-315° C) and surface layer 30a made of a low m.p. (e.g. Pb 37%Sn 63% m.p. about 180-185° C) formed on the entire surface of the body 29 and has an approximately spherical shape on the whole. The electrode body 29 may be made of a metal such as AuCuNi etc. having a higher m.p. than the solder.

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### CLAIMS

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[Claim(s)]

[Claim 1] Electronic parts which have a projection electrode comprising: A main part of a projection electrode which consists said projection electrode of high-melting point solder.

A projection electrode constituting by a projection electrode surface layer which consists of low melting point solder formed in the whole surface of this main part of a projection electrode.

[Claim 2] Electronic parts which have a projection electrode

characterized by the whole shape being almost spherical while shape of said main part of a projection electrode is pillar-shaped and said projection electrode surface layer is formed in the whole surface of this main part of a projection electrode in the invention according to claim 1.

[Claim 3] Electronic parts which have a projection electrode wherein said main part of a projection electrode consists of high-melting point solder which has the melting point of not less than 300 °C in the invention according to claim 1 or 2 and said projection electrode surface layer consists of low melting point solder which has the melting point of 200 °C or less.

[Claim 4] Electronic parts which have a projection electrode comprising: A main part of a projection electrode which consists said projection electrode of metal whose melting point is higher than solder. A projection electrode constituting by a projection electrode surface layer which consists of solder formed in the whole surface of this main part of a projection electrode.

[Claim 5] Electronic parts which have a projection electrode characterized by the whole shape being almost spherical while shape of said main part of a projection electrode is pillar-shaped and said projection electrode surface layer is formed in the whole surface of this main part of a projection electrode in the invention according to claim 4.

[Claim 6] A pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed on a connection pad of electronic parts. By heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of low melting point solder on this main part of a projection electrode and this projection electrode upper layer fuses and said main part of a projection electrode does not fuse. A formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.

[Claim 7] A pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed on a connection pad of electronic parts. By heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of solder on this main part of a projection electrode and this projection electrode upper layer fuses and said main part of a projection

electrode does not fuse  
A formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.

[Claim 8]  
A layer for substrate metal stratification is formed on a connection pad exposed via an opening provided in a protective film which was formed on a substrate of electronic parts and covered on this board and said protective film  
A plating resist layer is formed at not less than about 50 micrometers of thickness on said layer for substrate metal stratification except a portion corresponding to said connection pad  
A pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed in an opening formed in a portion corresponding to said connection pad of this plating resist layer  
Subsequently are on this main part of a projection electrode and the pillar-shaped projection electrode upper layer which consists of low melting point solder is formed in an opening of said plating resist layer  
By heat-treating at temperature which it exfoliates and said projection electrode upper layer subsequently fuses said plating resist layer and said main part of a projection electrode does not fuse  
A formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.

[Claim 9]  
A layer for substrate metal stratification is formed on a connection pad exposed via an opening provided in a protective film which was formed on a substrate of electronic parts and covered on this board and said protective film  
A plating resist layer is formed at not less than about 50 micrometers of thickness on said layer for substrate metal stratification except a portion corresponding to said connection pad  
A pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed in an opening formed in a portion corresponding to said connection pad of this plating resist layer  
Subsequently are on this main part of a projection electrode and the pillar-shaped projection electrode upper layer which consists of solder is formed in an opening of said plating resist layer  
By heat-treating at temperature which it exfoliates and said projection electrode upper layer subsequently fuses said plating resist layer and said main part of a projection electrode does not fuse  
A formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said

main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.

[Claim 10] Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solder and this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layer A bonding method of electronic parts which have a projection electrode carrying out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of low melting point solder formed in it.

[Claim 11] Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solder and this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layer A bonding method of electronic parts which have a projection electrode carrying out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of solder formed in it.

[Claim 12] A bonding method of electronic parts which have a projection electrode carrying out bonding of two or more said electronic parts on said 1st substrate in the invention according to claim 10 or 11.

[Claim 13] When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solder and this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layer By heat-treating at temperature which said projection electrode surface layer fuses first and said main part of a projection electrode does not fuse A bonding method of electronic parts which have a projection electrode fusing said projection electrode surface layer removing said electronic parts from on said substrate and carrying out the rebonding of these removed electronic parts on said substrate via said main part of a projection electrode subsequently.

[Claim 14] When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than

solder and this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layer. By heat-treating at temperature which said projection electrode surface layer fuses first and said main part of a projection electrode does not fuse. A bonding method of electronic parts which have a projection electrode fusing said projection electrode surface layer removing said electronic parts from on said substrate and carrying out the rebonding of these removed electronic parts on said substrate via said projection electrode surface layer which remains subsequently to the surface of said main part of a projection electrode.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode.

[0002]

[Description of the Prior Art] For example in the mounting technology of the semiconductor chip (electronic parts) called a flip chip manner. The projection electrode which consists of solder formed on the connection pad of a semiconductor chip is laid on the connection pad formed on the circuit board by heat-treating reflow (reflow) of the solder is carried out and bonding is performed. Therefore it is necessary to form in a semiconductor chip the projection electrode which consists of solder.

[0003] Next it explains referring to drawing 9 for the formation method of such a projection electrode. First as shown in drawing 9 (A) the connection pad 3 is formed on the insulator layer 2 arranged on the silicon (semiconductor) board 1. The protective film 4 is covered by the portion except the center section of the connection pad 3 of the upper surface and the center section of the connection pad 3 prepares what was exposed via the opening 5 provided in the protective film 4. Next as shown in drawing 9 (B) the layer 6 for substrate metal stratification is formed in the whole upper surface. Next the plating resist layer 7 is formed in the portion except the portion corresponding to the connection pad 3 of the upper surface of the layer 6 for substrate metal stratification. Therefore the opening 8 is formed in the plating resist

layer 7 in the portion corresponding to the connection pad 3 in this state. Next the projection electrode 9 which becomes the upper surface of the layer 6 for substrate metal stratification in the opening 8 of the plating resist layer 7 from solder is formed by performing electrolytic plating of solder by making the layer 6 for substrate metal stratification into a plating current way. In this case since he is trying for the thickness of the plating resist layer 7 to become comparatively thin with about 30 micrometers solder plating deposits isotropic on the plating resist layer 7. For this reason the projection electrode 9 in this state serves as mushroom shape. Let shape of the projection electrode 9 be mushroom shape in this stage in order to make into sufficient height the height of the final-shaped projection electrode explained below. Next the plating resist layer 7 is exfoliated. Next if the unnecessary portion of the layer 6 for substrate metal stratification is etched and removed by using the projection electrode 9 as a mask as shown in drawing 9 (C) the substrate metal layer 6a will be formed under the projection electrode 9. Next if it heat-treats as shown in drawing 9 (D) after the mushroom-shaped projection electrode 9 fuses it will be round with surface tension and will become almost spherical and the almost spherical projection electrode 9a will be formed by solidifying in this state.

[0004] Next drawing 10 carries out bonding of the semiconductor chip 11 of the above structures for example on the two-piece 1st circuit board 12 and shows the state where bonding of the 1st circuit board 12 was carried out on the 2nd circuit board 13. In performing such bonding it carries out bonding of the two semiconductor chips 11 on the 1st circuit board 12 via each of that projection electrode 9a first. Next bonding of the 1st circuit board 12 is carried out on the 2nd circuit board 13 via the projection electrode 14 which consists of solder formed in the undersurface. In this case although the 1st circuit board 12 is not illustrated wiring is formed in both sides and it has the structure where these wiring was electrically connected via the through hole conduction part. By this the two semiconductor chips 11 will electrically be connected to the 2nd circuit board 13 via the 1st circuit board 12.

[0005] On the other hand although explained referring to the expedient above figure 10 of explanation when bonding of the semiconductor chip 11 is carried out on the circuit board 12 this bonding may go wrong. In such a case by heat-treating first fuse the projection electrode 9a and the semiconductor chip 11 is removed from on the circuit board 12. Subsequently the solder which remained on the circuit board 12 is removed and subsequently bonding (repair) of another semiconductor chip 11

is carried out on the circuit board 12 via the projection electrode 9a. In this case another semiconductor chip 11 is used because the projection electrode 9a of the previous semiconductor chip 11 is destroyed and the reuse is impossible.

[0006]

[Problem(s) to be Solved by the Invention] However as shown in drawing 10 bonding of the semiconductor chip 11 is carried out for example on the two-piece 1st circuit board 12. In carrying out bonding of the 1st circuit board 12 on the 2nd circuit board 13. Since the projection electrode 9a of the semiconductor chip 11 is also fused when carrying out bonding of the 1st circuit board 12 on the 2nd circuit board 13 via that projection electrode 14 the shape of this fused projection electrode 9a may collapse greatly. In such a case there was a problem that the bonding strength by the projection electrode 9a might fall or a short circuit might occur. On the other hand when a rebonding was failed and carried out to bonding the solder which remained on the circuit board 12 had to be removed and there was a problem that the work was troublesome. Since the reuse became impossible by destruction of the projection electrode 9a even if the previous semiconductor chip 11 was an excellent article it will be discarded and there was a problem of being noneconomic. The purpose of this invention is to provide the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode in which the shape of the projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily at the time of bonding like the former. Solder can make it possible not to remain easily on a substrate at the time of bonding [like the latter] in which other purposes of this invention are: (1) in providing the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode which can carry out the reuse of the electronic parts which consist of a previous semiconductor chip etc.

[0007]

[Means for Solving the Problem] Electronic parts concerning the invention according to claim 1 constitute the projection electrode by main part of a projection electrode which consists of high-melting point solder and a projection electrode surface layer which consists of low melting point solder formed in the whole surface of this main part of a projection electrode. Electronic parts concerning the invention according to claim 4 constitute the projection electrode by main part of a projection electrode which consists of metal whose melting point is higher than

solder and a projection electrode surface layer which consists of solder formed in the whole surface of this main part of a projection electrode. A formation method of a projection electrode concerning the invention according to claim 6A pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed on a connection pad of electronic parts By heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of low melting point solder on this main part of a projection electrode and this projection electrode upper layer fuses and said main part of a projection electrode does not fuse While forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer it is made to make the whole shape almost spherical. A formation method of a projection electrode concerning the invention according to claim 7A pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed on a connection pad of electronic parts By heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of solder on this main part of a projection electrode and this projection electrode upper layer fuses and said main part of a projection electrode does not fuse While forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer it is made to make the whole shape almost spherical. A bonding method concerning the invention according to claim 10 Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solder and this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layer It is made to carry out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of low melting point solder formed in it. A bonding method concerning the invention according to claim 11 Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solder and this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layer It is made to carry out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of solder formed in



it. A bonding method concerning the invention according to claim 13 When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solder and this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layer By heat-treating at temperature which said projection electrode surface layer fuses first and said main part of a projection electrode does not fuse Said projection electrode surface layer is fused said electronic parts are removed from on said substrate and subsequently it is made to carry out the rebonding of these removed electronic parts on said substrate via said main part of a projection electrode. A bonding method concerning the invention according to claim 14 When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solder and this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layer By heat-treating at temperature which said projection electrode surface layer fuses first and said main part of a projection electrode does not fuse Said projection electrode surface layer is fused said electronic parts are removed from on said substrate and subsequently to the surface of said main part of a projection electrode it is made to carry out the rebonding of these removed electronic parts on said substrate via said projection electrode surface layer which remains.

[0008]

[Function] In an invention given in claims 16 and 10 when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of low melting point solder formed in it the original form will be maintained as it is without the main part of a projection electrode which consists of high-melting point solder of electronic parts fusing.

Therefore the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily. In an invention given in claims 47 and 11 when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of solder formed in it the original form will be maintained as it is without the main part of a projection electrode which consists of metal whose melting point is higher than the solder of electronic parts

fusing.

Therefore the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily. In an invention given in claims 16 and 13. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the low melting point solder it is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of low melting point solder first fuses and consists of high-melting point solder does not fuse.

Therefore though the main part of a projection electrode which consists of high-melting point solder does not fuse but solder remains on a substrate it is a part of projection electrode surface layer which consists of low melting point solder therefore solder can make it possible not to remain easily on a substrate.

And since the main part of a projection electrode which consists of high-melting point solder of the removed electronic parts is maintaining the original form as it is the reuse of the electronic parts which can carry out a rebonding on a substrate via this main part of a projection electrode therefore consist of a previous semiconductor chip etc. can be carried out. In an invention given in claims 47 and 14. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the solder it is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of solder first fuses and consists of metal whose melting point is higher than solder does not fuse.

Therefore though the main part of a projection electrode which consists of metal whose melting point is higher than solder does not fuse but solder remains on a substrate it is a part of projection electrode surface layer which consists of solder therefore solder can make it possible not to remain easily on a substrate.

And since the main part of a projection electrode which consists of metal whose melting point is higher than the solder of the removed electronic parts is maintaining the original form as it is the reuse of the electronic parts which can carry out a rebonding on a substrate via the projection electrode surface layer which remains on the surface of this main part of a projection electrode therefore consist of a previous semiconductor chip etc. can be carried out.

[0009]

[Example] Drawing 1 (A) - (C) shows each formation process of the

projection electrode in the 1st example of this invention respectively. Then referring to these figures in order it combines with that formation method and the structure of the projection electrode of this example is explained.

[0010] First as shown in drawing 1 (A) the connection pad 23 which consists of aluminum or aluminum alloy etc. is formed on the insulator layer 22 which consists of silicon oxide etc. which have been arranged on the silicon (semiconductor) board 21. The protective film 24 which becomes a portion except the center section of the connection pad 23 of the upper surface from silicon oxide, silicon nitride etc. is covered and the center section of the connection pad 23 prepares what was exposed via the opening 25 provided in the protective film 24.

[0011] Next as shown in drawing 1 (B) the layer 26 for substrate metal stratification is formed in the whole upper surface. This layer 26 for substrate metal stratification is a three-tiered structure and as an example it consists of a layer formed in about 2000-4000 Å of thickness by vacuum evaporation or sputtering etc. using the titanium tungsten (Ti-W) alloy which is a good metallic material of adhesion with aluminum (aluminum) whose 1st layer is a metallic material of the connection pad 23 from the silicon substrate 21 side. It consists of a layer which is for a two-layer eye to prevent scaling of the 1st layer and is formed in about 5000-10000 Å of thickness by vacuum evaporation or sputtering etc. using copper (Cu). It consists of a layer which is for the 3rd layer to prevent diffusion of solder and is formed in about 1000-2000 Å of thickness by plating using nickel (nickel).

[0012] Next the plating resist layer 27 is formed in the portion except the portion corresponding to the connection pad 23 of the upper surface of the layer 26 for substrate metal stratification comparatively thickly with about 50-150 micrometers of thickness. The opening 28 is formed in the plating resist layer 27 in the portion corresponding to the connection pad 23 in this state. In this case after forming the plating resist layer 27 in all the upper surfaces with a spin coat form the opening 28 by a photolithography but. As conditions for a spin coat when the viscosity of plating resist is about 2500-3000 cP, the number of rotations shall be about 500 rpm when number of rotations shall be about 1000 rpm, thickness can be about 50-150 micrometers and the viscosity of plating resist is about 1500-2000 cP, thickness can be about 50-150 micrometers.

[0013] Next by performing electrolytic plating of solder by making the layer 26 for substrate metal stratification into a plating current way. The melting point on the upper surface of the layer 26 for substrate

metal stratification in the opening 28 of the plating resist layer 27 Not less than 300 \*\* high-melting point solder. The main part 29 of a projection electrode which consists of (for example Pb95%:Sn5% and the melting point of about 310-315 \*\*) is formed in predetermined height Subsequently the melting point forms in the upper surface of the main part 29 of a projection electrode in the opening 28 the projection electrode upper layer 30 which consists of low melting point solder (for example Pb37%:Sn63% the melting point of about 180-185 \*\*) 200 \*\* or less. In this case since the main part 29 of a projection electrode and the projection electrode upper layer 30 are formed only in the opening 28 of the plating resist layer 27 the shape of the main part 29 of a projection electrode in this state and the projection electrode upper layer 30 becomes pillar-shaped. Next the plating resist layer 27 is exfoliated. Next if the unnecessary portion of the layer 26 for substrate metal stratification is etched and removed by using the projection electrode upper layer 30 and the main part 29 of a projection electrode as a mask as shown in drawing 1 (C) the substrate metal layer 26a will be formed under the main part 29 of a projection electrode. In this way the projection electrode in this example is formed.

[0014] Next drawing 2 carries out bonding of the semiconductor chip 31 of the above structures for example on the two-piece 1st circuit board 32 and shows the state where bonding of the 1st circuit board 32 was carried out on the 2nd circuit board 33. In this case although the 1st circuit board 32 is not illustrated in detail it is the double-side wiring structure electrically connected via the through hole conduction part. The connection pad 34 is formed in a predetermined part on top and the almost spherical projection electrode 35 in which the melting point consists of low melting point solder (for example Pb37%:Sn63% the melting point of about 180-185 \*\*) 200 \*\* or less is formed in the predetermined part at the bottom. The connection pad 36 is formed in the predetermined part of the upper surface of the 2nd circuit board 33.

[0015] And in performing bonding first alignment of each projection electrode upper layer 30 of the two semiconductor chips 31 is carried out on the connection pad 34 of the 1st circuit board 32 and it arranges it. Next at the temperature which low melting point solder fuses and high-melting point solder does not fuse for example by solidifying after the projection electrode upper layer 30 fuses if it heat-treats at the temperature of about 200-290 \*\* Bonding of the two semiconductor chips 31 is carried out on the 1st circuit board 32 via each of that projection electrode upper layer 30. In this case the main part 29 of a projection electrode which consists of high-melting point solder will maintain the

original form as it is without fusing. On the other hand although the projection electrode 35 of the 1st circuit board 32 is fused since it only merely fuses when it solidifies the almost spherical original form will be maintained.

[0016] Next alignment of the projection electrode 35 of the 1st circuit board 32 is carried out on the connection pad 36 of the 2nd circuit board 33 and it is arranged. Next if it heat-treats at the temperature of about 200-290 °C with the temperature which low melting point solder fuses and high-melting point solder does not fuse bonding of the 1st circuit board 32 will be carried out on the 2nd circuit board 33 via the projection electrode 35 by solidifying after the projection electrode 35 fuses. In this case although the projection electrode upper layer 30 of the semiconductor chip 31 is also fused since the original form will be maintained as it is without the main part 29 of a projection electrode which consists of high-melting point solder fusing the shape as the whole projection electrode which consists of the main part 29 of a projection electrode and the projection electrode upper layer 30 cannot collapse easily. As a result the fall of bonding strength and short circuit resulting from collapse of the shape of a projection electrode can be prevented from generating.

[0017] Next the case where a rebonding (repair) is failed and carried out to the bonding to the circuit board 32 top of the semiconductor chip 31 is explained from the original process referring to the expedient above figure 2 of explanation. First alignment of the projection electrode upper layer 30 of the semiconductor chip 31 is carried out on the connection pad 34 of the circuit board 32 and it is arranged. Next if it heat-treats at the temperature of about 200-290 °C with the temperature which low melting point solder fuses and high-melting point solder does not fuse bonding of the semiconductor chip 31 will be carried out on the circuit board 32 via the projection electrode upper layer 30 by solidifying after the projection electrode upper layer 30 fuses.

[0018] However suppose that this bonding went wrong. Then next if it heat-treats at the temperature of about 200-290 °C with the temperature which low melting point solder fuses and high-melting point solder does not fuse the projection electrode upper layer 30 will fuse and the semiconductor chip 31 will be removed from on the circuit board 32. In this case since the main part 29 of a projection electrode does not fuse only the projection electrode upper layer 30 is destroyed. Though solder remains on the connection pad 34 of the circuit board 32 it is a part of projection electrode upper layer 30 which consists of low melting point solder therefore solder can make it possible not to remain

easily on the connection pad 34 of the circuit board 32. Since the main part 29 of a projection electrode which consists of high-melting point solder of the removed semiconductor chip 31 is maintaining the original form the rebonding through this main part 29 of a projection electrode is possible for it.

[0019] Then next alignment of the main part 29 of a projection electrode of the removed semiconductor chip 31 is carried out on the connection pad 34 of the circuit board 32 and it is arranged. Next if it heat-treats at the temperature of not less than 300 °C with the temperature which high-melting point solder fuses the rebonding of the semiconductor chip 31 will be carried out on the circuit board 32 via the main part 29 of a projection electrode by solidifying after the main part 29 of a projection electrode fuses. In this way the reuse of the semiconductor chip 31 removed once can be carried out.

[0020] By the way in the above-mentioned examples since the pillar-shaped projection electrode upper layer 30 is formed on the pillar-shaped main part 29 of a projection electrode and the whole shape is made pillar-shaped as shown in drawing 1 (B) and (C) as compared with the case where it is shown in drawing 9 it has the following advantages. That is as compared with the case where the projection electrode 9 of mushroom shape as shown in drawing 9 (C) is formed only the part equivalent to the portion of the umbrella of a mushroom can make the occupation area of a projection electrode small and the pitch of a projection electrode can be made small by extension. As shown in drawing 9 (D) in heat-treating after plating treatment and forming the almost spherical projection electrode 9a although it is easy to produce dispersion in the height of the projection electrode 9a if the projection electrodes 29 and 30 are formed only by plating treatment it can be hard to produce dispersion in the height like the above-mentioned example.

[0021] However the shape of a projection electrode is not limited to the above-mentioned example. For example if it heat-treats at the temperature of about 200-290 °C with the temperature which the projection electrode upper layer 30 fuses and the main part 29 of a projection electrode does not fuse in the state which shows in drawing 1 (C) by only the projection electrode upper layer's (low melting point solder's) 30 fusing being round with surface tension while this fused low melting point solder spreads on the whole surface of the main part 29 of a projection electrode and solidifying in this state while the projection electrode surface layer 30a is formed in the whole surface of the main part 29 of a projection electrode it may be made for the whole shape to become almost spherical like the 2nd example shown in drawing 3.

[0022]Like the 3rd example shown in drawing 4 by heat-treating at the temperature of not less than 300 °C with the temperature which high-melting point solder fuses in the state which shows for example in drawing 1 (C) while making almost spherical the main part 29a of a projection electrode. The whole surface of this main part 29a of a projection electrode is made to cover the projection electrode surface layer 30a and it may be made for the whole shape to become almost spherical.

[0023]Next drawing 5 (A) - (C) shows each formation process of the projection electrode in the 4th example of this invention respectively. Then referring to these figures in order it combines with that formation method and the structure of the projection electrode of this example is explained. First as shown in drawing 5 (A) the same thing as what is shown in drawing 1 (A) is prepared. Therefore in drawing 5 (A) the same numerals are given to drawing 1 (A) and identical parts and the explanation is omitted.

[0024]Next as shown in drawing 5 (B) the layer 41 for substrate metal stratification is formed in the whole upper surface. Next the plating resist layer 42 is formed in the portion except the portion corresponding to the connection pad 23 of the upper surface of the layer 41 for substrate metal stratification. Therefore the opening 43 is formed in the plating resist layer 42 in the portion corresponding to the connection pad 23 in this state. In this case the thickness of the plating resist layer 42 is comparatively thin with about 30 micrometers. Next by performing electrolytic plating of solder by making the layer 41 for substrate metal stratification into a plating current way. The main part 44 of a projection electrode which becomes the upper surface of the layer 41 for substrate metal stratification in the opening 43 of the plating resist layer 42 from high-melting point solder is formed and the projection electrode upper layer 45 which consists of low melting point solder subsequently to the upper surface of the main part 44 of a projection electrode and the upper surface of the plating resist layer 42 of the circumference is formed. In this case since low melting point solder plating is deposited isotropically the umbrella-like projection electrode upper layer 45 will be formed on the pillar-shaped main part 44 of a projection electrode. Next the plating resist layer 42 is exfoliated. Next if the unnecessary portion of the layer 41 for substrate metal stratification is etched and removed by using the projection electrode upper layer 45 and the main part 44 of a projection electrode as a mask as shown in drawing 5 (C) the substrate metal layer 41a will be formed under the main part 44 of a projection electrode. In this way the

projection electrode in this example is formed.

[0025] If it heat-treats at the temperature of about 200-290 °C with the temperature which the projection electrode upper layer 45 fuses and the main part 44 of a projection electrode does not fuse in the state which shows in drawing 5 (C) By only the projection electrode upper layer's (low melting point solder's) 45 fusing being round with surface tension while this fused low melting point solder spreads on the whole surface of the main part 44 of a projection electrode and solidifying in this state while the projection electrode surface layer 45a is formed in the whole surface of the main part 44 of a projection electrode it may be made for the whole shape to become almost spherical like the 5th example shown in drawing 6. In this case like the 6th example shown in drawing 7 by heat-treating at the temperature which high-melting point solder fuses while making almost hemispherical the main part 44a of a projection electrode the whole surface of this main part 44a of a projection electrode is made to cover the projection electrode surface layer 45a and it may be made for the whole shape to become almost spherical.

[0026] It is good also as a structure which made the upper part of the main part 44 of a projection electrode the shape of an umbrella and formed the umbrella-like projection electrode surface layer 45 in the upper surface like the 7th example shown in drawing 8. In each example shown in drawing 1 drawing 3 drawing 5 drawing 6 and drawing 8 respectively the main parts 29 and 44 of a projection electrode are formed by the electrolytic plating of metals such as gold (Au) whose melting point is bigger than solder, copper (Cu) and nickel (nickel) and it may be made to form the projection electrode upper layers (surface layer) 30 and 45 (30a45a) by the electrolytic plating of the solder whose melting point is lower than it. When it does in this way and a rebonding (repair) is carried out rebonding (repair) will be carried out by using the solder which consists of a part of projection electrode upper layers (surface layer) 30 and 45 (30a45a) which remain on the surface of the main parts 29 and 44 of a projection electrode. The electronic parts which have a projection electrode may be other electronic parts of not only a semiconductor chip but the 1st circuit board 32 grade shown for example in drawing 2.

[0027]

[Effect of the Invention] As explained above when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of low melting point solder formed in it in an invention given in claims 16 and 10 the original form will be maintained as it is without the main part of a projection electrode which consists of



high-melting point solder of electronic parts fusing.

Therefore the fall of bonding strength and short circuit which the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily and originate in collapse of the shape of a projection electrode by extension can be prevented from generating.

In an invention given in claims 47 and 11 when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of solder formed in its original form will be maintained as it is without the main part of a projection electrode which consists of metal whose melting point is higher than the solder of electronic parts fusing.

Therefore the fall of bonding strength and short circuit which the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily and originate in collapse of the shape of a projection electrode by extension can be prevented from generating.

In an invention given in claims 16 and 13. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the low melting point solder it is heat-treated at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of low melting point solder first fuses and consists of high-melting point solder does not fuse.

Therefore though the main part of a projection electrode which consists of high-melting point solder does not fuse but solder remains on a substrate it is a part of projection electrode surface layer which consists of low melting point solder therefore solder can make it possible not to remain easily on a substrate.

And since the main part of a projection electrode which consists of high-melting point solder of the removed electronic parts is maintaining the original form as it is the reuse of the electronic parts which can carry out a rebonding on a substrate via this main part of a projection electrode therefore consist of a previous semiconductor chip etc. can be carried out. In an invention given in claims 47 and 14. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the solder it is heat-treated at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of solder first fuses and consists of metal whose melting point is higher than solder does not fuse.

Therefore though the main part of a projection electrode which consists of metal whose melting point is higher than solder does not fuse but solder remains on a substrate it is a part of projection electrode surface layer which consists of solder therefore solder can make it possible not to remain easily on a substrate.

And since the main part of a projection electrode which consists of metal whose melting point is higher than the solder of the removed electronic parts is maintaining the original form as it is the reuse of the electronic parts which can carry out a rebonding on a substrate via the projection electrode surface layer which remains on the surface of this main part of a projection electrode therefore consist of a previous semiconductor chip etc. can be carried out.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] (A) - (C) is a sectional view showing each formation process of the projection electrode in the 1st example of this invention respectively.

[Drawing 2] The figure shown in order to explain an example of the bonding of this invention.

[Drawing 3] The sectional view shown in order to explain the projection electrode in the 2nd example of this invention.

[Drawing 4] The sectional view shown in order to explain the projection electrode in the 3rd example of this invention.

[Drawing 5] (A) - (C) is a sectional view showing each formation process of the projection electrode in the 4th example of this invention respectively.

[Drawing 6] The sectional view shown in order to explain the projection electrode in the 5th example of this invention.

[Drawing 7] The sectional view shown in order to explain the projection electrode in the 6th example of this invention.

[Drawing 8] The sectional view shown in order to explain the projection electrode in the 7th example of this invention.

[Drawing 9] (A) - (D) is a sectional view showing each formation process of the conventional projection electrode respectively.

[Drawing 10] The figure shown in order to explain an example of the conventional bonding.

[Description of Notations]

21 Silicon substrate

23 Connection pad  
29 The main part of a projection electrode  
30 Projection electrode upper layer  
30a Projection electrode surface layer

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